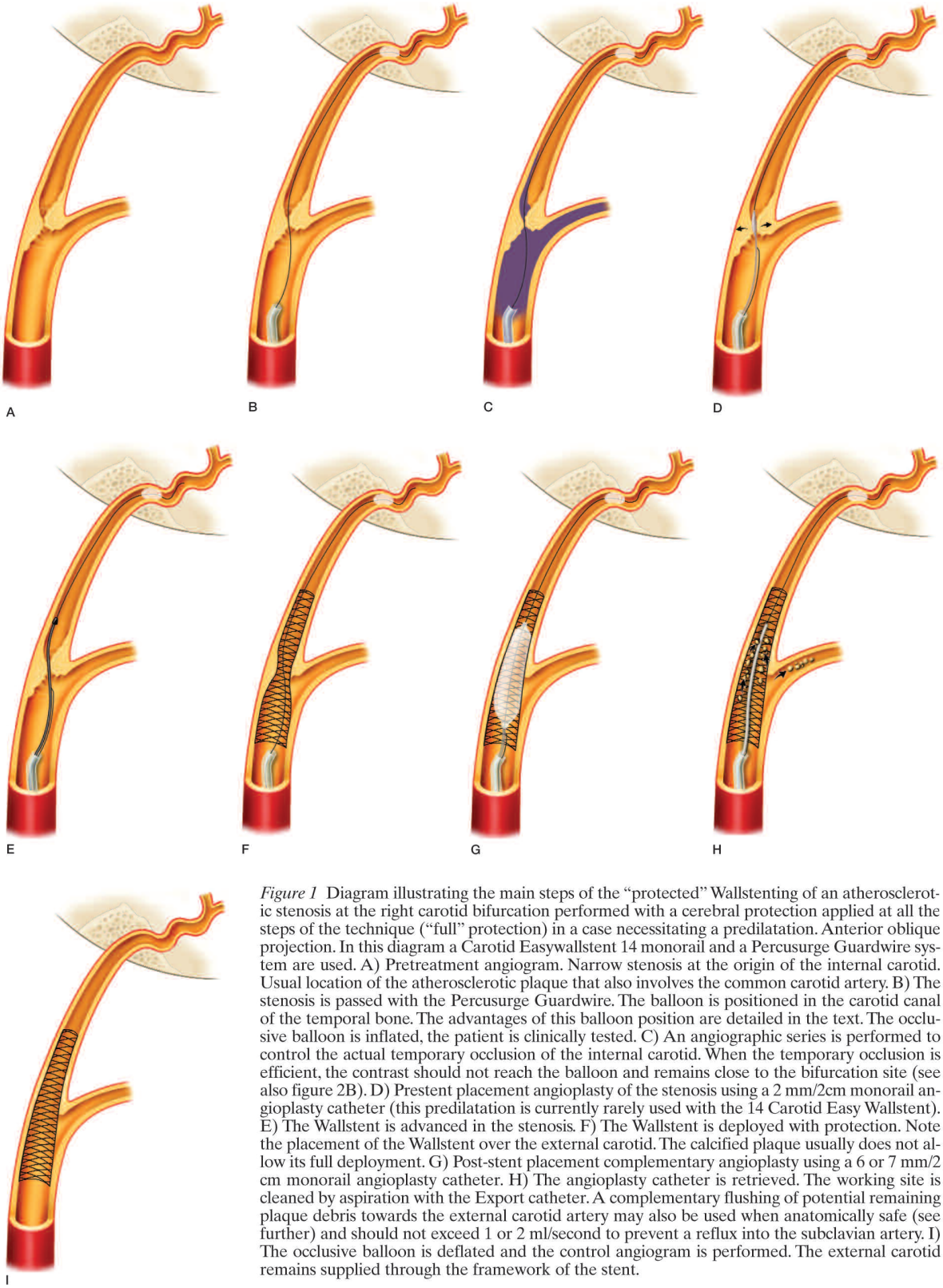

Figure 1 Diagram illustrating the main steps of the "protected" Wallstenting of an atherosclerotic stenosis at the right carotid bifurcation performed with a cerebral protection applied at all the steps of the technique ("full" protection) in a case necessitating a predilatation. Anterior oblique projection. In this diagram a Carotid Easywallstent 14 monorail and a Percusurge Guardwire system are used. A) Pretreatment angiogram. Narrow stenosis at the origin of the internal carotid. Usual location of the atherosclerotic plaque that also involves the common carotid artery. B) The stenosis is passed with the Percusurge Guardwire. The balloon is positioned in the carotid canal of the temporal bone. The advantages of this balloon position are detailed in the text. The occlusive balloon is inflated, the patient is clinically tested. C) An angiographic series is performed to control the actual temporary occlusion of the internal carotid. When the temporary occlusion is efficient, the contrast should not reach the balloon and remains close to the bifurcation site (see also figure 2B). D) Prestent placement angioplasty of the stenosis using a 2 mm/2cm monorail angioplasty catheter (this predilatation is currently rarely used with the 14 Carotid Easy Wallstent). E) The Wallstent is advanced in the stenosis. F) The Wallstent is deployed with protection. Note the placement of the Wallstent over the external carotid. The calcified plaque usually does not allow its full deployment. G) Post-stent placement complementary angioplasty using a 6 or 7 mm/2 cm monorail angioplasty catheter. H) The angioplasty catheter is retrieved. The working site is cleaned by aspiration with the Export catheter. A complementary flushing of potential remaining plaque debris towards the external carotid artery may also be used when anatomically safe (see further) and should not exceed 1 or 2 ml/second to prevent a reflux into the subclavian artery. I) The occlusive balloon is deflated and the control angiogram is performed. The external carotid remains supplied through the framework of the stent.

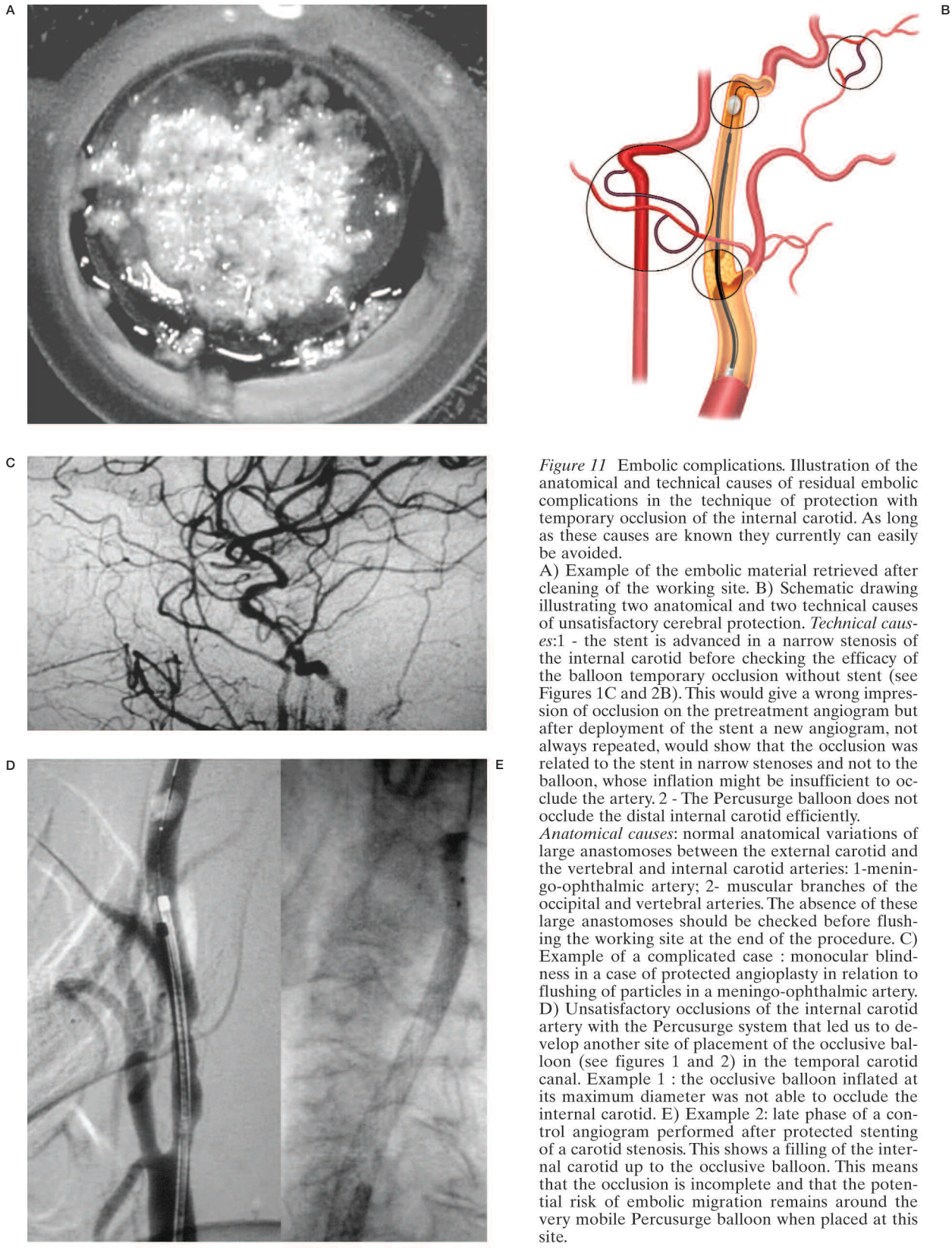

Figure 11 Embolic complications. Illustration of the anatomical and technical causes of residual embolic complications in the technique of protection with temporary occlusion of the internal carotid. As long as these causes are known they currently can easily be avoided.
A) Example of the embolic material retrieved after cleaning of the working site. B) Schematic drawing illustrating two anatomical and two technical causes of unsatisfactory cerebral protection. *Technical causes*:1 - the stent is advanced in a narrow stenosis of the internal carotid before checking the efficacy of the balloon temporary occlusion without stent (see Figures 1C and 2B). This would give a wrong impression of occlusion on the pretreatment angiogram but after deployment of the stent a new angiogram, not always repeated, would show that the occlusion was related to the stent in narrow stenoses and not to the balloon, whose inflation might be insufficient to occlude the artery. 2 - The Percusurge balloon does not occlude the distal internal carotid efficiently.
Anatomical causes: normal anatomical variations of large anastomoses between the external carotid and the vertebral and internal carotid arteries: 1-meningo-ophthalmic artery; 2- muscular branches of the occipital and vertebral arteries. The absence of these large anastomoses should be checked before flushing the working site at the end of the procedure. C) Example of a complicated case : monocular blindness in a case of protected angioplasty in relation to flushing of particles in a meningo-ophthalmic artery. D) Unsatisfactory occlusions of the internal carotid artery with the Percusurge system that led us to develop another site of placement of the occlusive balloon (see figures 1 and 2) in the temporal carotid canal. Example 1 : the occlusive balloon inflated at its maximum diameter was not able to occlude the internal carotid. E) Example 2: late phase of a control angiogram performed after protected stenting of a carotid stenosis. This shows a filling of the internal carotid up to the occlusive balloon. This means that the occlusion is incomplete and that the potential risk of embolic migration remains around the very mobile Percusurge balloon when placed at this site.